



Department Of Fire Services

Massachusetts Firefighting Academy

Technical Rescue Programs



CONFINED SPACE RESCUE: TECHNICIAN LEVEL

STUDENT MANUAL

Reasons for the failure of Technical Rescue Operations

Acronym: FAILURE

F - Failure to understand or underestimating the environment

A- Additional medical implications not considered

I- Inadequate rescue skills

L- Lack of team work and experience

U- Understanding the logistical needs of the operation

R- Rescue versus recovery mode not considered

E- Equipment not mastered

Slide 1



Slide 2



Slide 3



Slide 4

**DEFINITION OF A
CONFINED SPACE**

- 1. Is large enough and so configured that an employee can bodily enter and perform assigned work;

4

Slide 5

**DEFINITION OF A
CONFINED SPACE**

- 2. Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry);

5

Slide 6

**DEFINITION OF A
CONFINED SPACE**

- 3. Is not designed for continuous employee occupancy.

6

Slide 7

**DEFINITION OF PERMIT
CONFINED SPACE**

- Permit Space means a confined space that has one or more of the following characteristics:

Slide 8

**DEFINITION OF PERMIT
CONFINED SPACE**

- 1. Contains or has a potential to contain a hazardous atmosphere;

Slide 9

**DEFINITION OF PERMIT
CONFINED SPACE**

- 2. Contains a material that has the potential for engulfing an entrant;

Slide 10

DEFINITION OF PERMIT CONFINED SPACE

- **3. Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section;**

10

Slide 11

DEFINITION OF PERMIT CONFINED SPACE

- 4. Contains any other recognized serious safety or health hazard.

Slide 12

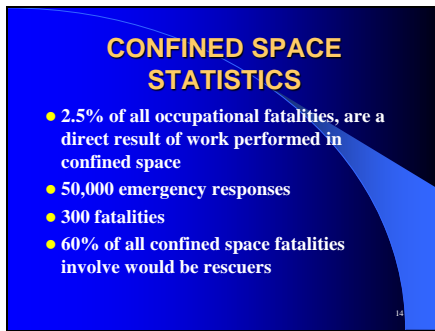
CONFINED SPACES

- Storage tanks
- Sewers/manholes
- Holds of ships
- Underground utility vaults
- Boilers/pipelines
- Septic tank
- Sewerage digester
- Machinery housings
- Reaction vessels
- Silos
- Truck and rail tank cars
- Ducts
- Pits and ditches

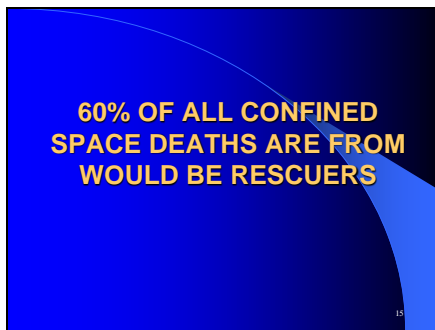
Slide 13



Slide 14



Slide 15



Slide 16

HOW DO WE PREVENT THIS?

- Good Training
- Risk Benefit Analysis
- Rescue or Recovery mode

16

Slide 17

WHAT CONFINED SPACE ENTAILS

ROPE SKILLS
And
HAZMAT SKILLS

- Atmospheric monitoring
- Protective breathing
- Rigging

17

Slide 18

HAZARDS OF CONFINED SPACES

- Hazardous Atmospheres
- Deficient O2 below 19.5%
– (most frequent)
- Enriched O2
- Flammable Gas & Vapors
- Toxic (CO, H2S)

18

Slide 19

PHYSICAL AND MECHANICAL HAZARDS

- Engulfment – Liquids & Powders
- Entrapment – Walls, Floors, Narrow Passages
- Contact with moving machinery
- Contact with Electrical Equipment
- Asphyxiation atmospheres
- Flammable atmospheres

19

Slide 20

PHYSICAL AND MECHANICAL HAZARDS

- Noise
- Heat/Cold
- Falls
- Isolating a Confined Space

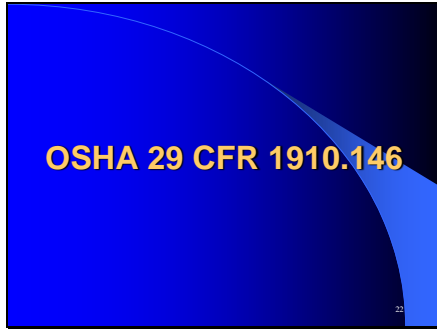
20

Slide 21

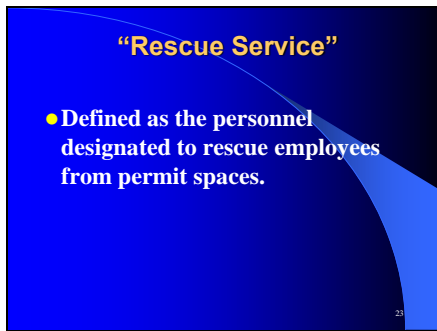
CASE STUDIES

21

Slide 22



Slide 23



Slide 24



Slide 25

BASIC ROLES IN INDUSTRIAL CONFINED SPACE

- Entry Supervisor
- Attendant
- Entrant
- Permit – Check off list
- Standby – Rescue Team

25

Slide 26

AUTHORIZED ENTRANT

An employee who is authorized by the employer to enter a space

26

Slide 27

DUTIES OF AUTHORIZED ENTRANT

- Familiar with hazards that could be encountered
- Proper use of all equipment
- Communicate with attendant
- Alert attendant of :dangerous or prohibited condition

27

Slide 28

DUTIES OF AUTHORIZED ENTRANT

- Exit permit space as quickly as possible when:
 - ordered to evacuate,
 - recognize warning sign or symptom
 - exposed to dangerous situation or prohibited condition
 - evacuation alarm activated

28

Slide 29

ATTENDANT

Individual stationed outside one or more permit spaces who monitors the authorized entrants and performs all attendant's duties assigned in the employer's permit space program

29

Slide 30

DUTIES OF ATTENDANT

- Know hazards that might be encountered during entry
- Aware of behavioral effects of hazard exposure to authorized entrants
- Continuously maintains accountability
- Remains at space until relieved or entry terminated
- Performs non-entry rescues

30

Slide 31

ENTRY SUPERVISOR

Person responsible for determining if acceptable entry conditions are present at a permit space where entry is planned, for authorizing entry and overseeing entry operations, and for terminating entry as required.

31

Slide 32

DUTIES OF ENTRY SUPERVISOR

- Know hazards that will be encountered
- Verifies by checking:
 - *appropriate entries made on permit*
 - *all specified tests conducted*
 - *all specified equipment in place*

32

Slide 33

DUTIES OF ENTRY SUPERVISOR

Determines, whenever responsibility for a permit space entry operation is transferred and at intervals dictated by the hazards and operations performed within the space, that entry operations remain consistent with the terms of the entry permit and that acceptable entry conditions are maintained

33

Slide 34

PERMIT SYSTEM

A permit signed by the entry supervisor and verifying that pre-entry preparations have been completed and that the space is safe to enter, must be posted at entrances or otherwise made available to entrants before they enter a permit space

[illegible]

34

Slide 35

ENTRY PERMITS

MUST INCLUDE THE FOLLOWING INFORMATION:

- Name and signature of supervisor who authorizes entry;
- Name of permit space to be entered, authorized entrants, eligible attendants, and individuals authorized to be entry supervisors;
- Purpose of entry and know space hazards;
- Test results;
- Testers signature or initials

35

Slide 36

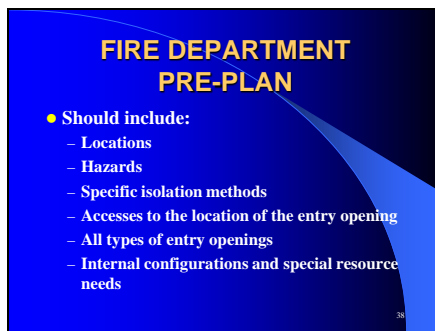
ENTRY PERMITS

- Measures to be taken to isolate permit spaces and to eliminate or control space hazards (lockout/tagout, purging, inerting, flushing, and ventilation)
- Names and numbers of Rescue and EMS
- Date and duration of entry
- Communication equipment and procedures
- Additional permits
- Special equipment and PPE
- Any other info needed to ensure safety

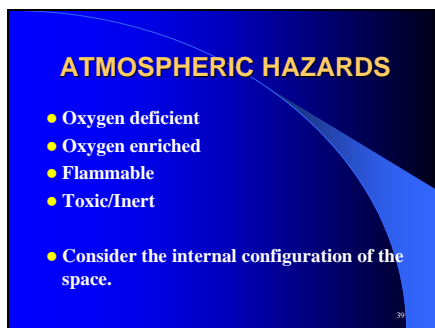
Slide 37



Slide 38



Slide 39



Slide 40

ATMOSPHERIC HAZARDS

- **Oxygen deficient**- of 173 fatalities in confined spaces, 67 were attributed oxygen deficient atmospheres
- Oxygen levels below 19.5 % by volume are considered unsafe and can result from either consumption or displacement
- Oxygen consumption can be caused by :
Combustion, Decomposition of organic matter, Oxidation of metals

40

Slide 41

ATMOSPHERIC HAZARDS

- **Oxygen Enriched**, oxygen level greater than 23.5% a very serious fire hazard.
-flammable materials like clothing and hair will burn very rapidly in oxygen enriched atmosphere
-Never ventilate with O2

41

Slide 42

ATMOSPHERIC HAZARDS

Effects of various oxygen levels

- 23.5% and above, oxygen enriched and extreme fire hazard
- 21% Normal concentration of atmosphere we live in
- 19.5% Minimum "safe level" set by NIOSH
- 15% Disorientation and impaired judgment and breathing
- 14% Faulty judgment and rapid fatigue
- 8% Mental failure, loss of consciousness
- 6% Difficulty breathing , rapid death

42

Slide 43

ATMOSPHERIC HAZARDS

Flammable atmospheric hazards

For fire or explosion to occur three components must be present:


- A fuel (*such as a combustible gas*)
 - The specific mixture of fuel that will ignite or explode (*flammable range*) varies with each combustible gas
- Oxygen
- Ignition source

43

Slide 44

FLAMMABLE RANGE

THE **flammable range** is the range between the **LEL** (*Lower Explosive Limit*) and **UEL** (*Upper Explosive Limit*)



A horizontal scale from 0 to 1.00 with a red line at 0.22 and a blue line at 0.95. A red box labeled 'PROPANE FLAMMABLE RANGE 2.2-9.5' is positioned above the scale.

44

Slide 45

FLAMMABLE ATMOSPHERIC HAZARD

- Flammable gas, vapor, or mist in excess of:
10% of its *Lower Explosive Limit*

45

Slide 46

ATMOSPHERIC HAZARDS
TOXIC

- Measured in parts per million (ppm)
- 10,000 ppm = 1%
- Carbon Monoxide (CO) and Hydrogen Sulfide(H₂S) are the most common toxins found in confined spaces.
- Toxic levels, atmospheric concentration of any substance above the permissible exposure limit(PEL).

Slide 47

ATMOSPHERIC HAZARDS
TOXIC

- Any atmospheric condition that is immediately dangerous to life or health (IDLH).
- Product stored in space, Product absorbed in walls
- Sludge removal
- Work being performed
 - Welding, cutting, degreasing, cleaning solvents& migration of products into space from outside

Slide 48

ATMOSPHERIC HAZARDS

- Due to physical properties all areas of space must be tested
 - Important to determine internal configuration of space
- Check permits /MSDS for information on product including vapor density, vapor pressure, toxicity

Slide 49

ATMOSPHERIC HAZARDS

INERTED ATMOSPHERIC HAZARDS

- Inerting means the displacement of the atmosphere in a permit space by a non-combustible gas (such as nitrogen) to such extent that resulting atmosphere is non-combustible. *This procedure produces an IDLH oxygen deficient atmosphere*

49

Slide 50

ENGULFMENT HAZARD

- Engulfment- means the surrounding and effective capture of a person by a liquid or finely divided (flowable solid) substance that can be aspirated to cause death by filling or plugging the respiratory system or that can exert enough force on the body to cause death by strangulation, constriction, or by crushing.

50

Slide 51

HAZARD CONTROL

- For each hazard identified, the employer must develop and implement appropriate control measure to protect authorized entrants.
- The specific control measures implemented will be dictated by the characteristics of each individual space.

51

Slide 52

CONTROL MEASURES

- Mechanical ventilation
- PPE
- Communication equipment
- Hot work policies
- Isolation of permit spaces
- Atmospheric testing
- Cleaning, purging, or inerting
- Lockout/tagout
- Blanking or blinding of pipes

52

Slide 53

ATMOSPHERIC MONITORING AND TESTING

Important to identify hazards and monitor for change

Order of testing

- O₂
- Flammable Gas/Vapor
- Toxicity

53

Slide 54

ATMOSPHERIC TESTING AND MONITORING

Help to determining Tactics & Strategies

54

Slide 55

BASIC EQUIPMENT

Atmospheric Monitoring

Respiratory Protection

- S.C.B.A.
- S.A.R.



55


Slide 56

BASIC EQUIPMENT

- Retrieval Equipment
- Mechanical Advantage
- Class III Harness

Consider

- Vertical Lift
- Horizontal Movement




56

Slide 57

VENTILATION EQUIPMENT

- Is it needed?
- Positive or Negative?
- What will it do to the atmosphere?



57

Slide 58

COMMUNICATION EQUIPMENT

- Reliable, Safe for the atmosphere
- Must have back up means of communicating
- Doesn't affect atmospheric monitoring equipment



58

Slide 59

COMMUNICATION EQUIPMENT

O.A.T.H.

- Radios
 - O – O.K.
- Hard Wired Systems
 - A – ADVANCE
 - T – TAKE UP
 - H – HELP

59

Slide 60

EXTRICATION DEVICES

- LSP Halfback
- SKED
- Miller Full Body Splint
- KED
- Victim Harness



60

Slide 61

PERSONAL PROTECTIVE EQUIPMENT

- Rescue Helmet
- Fire Rated Coveralls/Hood/Gloves
- Footwear
- Eye Protection
- Hearing Protection
- Class III Harness
- Communications and Lighting


61

- **Rescue Helmet**
- **Fire Rated Coveralls/Hood/Gloves**
- **Footwear**
- **Eye Protection**
- **Hearing Protection**
- **Class III Harness**
- **Communications and Lighting**

Slide 62

LIGHTS

- Intrinsically safe
- 3 Sources



- **Intrinsically safe**
- **3 Sources**



Slide 63

TRAINED AND ORGANIZED
TEAM UNDER ICS

63

**TRAINED AND ORGANIZED
TEAM UNDER ICS**

Slide 64

PHASES OF CONFINED SPACE RESCUE

- Make the scene safe
- Victim contact
- Size Up
- Preparation
- Access the patient
- Stabilize and package the patient
- Evacuate

Slide 65

MAKE THE SCENE SAFE

- Hazard assessment
 - (1) Atmospheric hazards
 - (2) Chemical hazards
 - (3) Temperature extremes
 - (4) Engulfment and entrapment
 - (5) Any other recognized safety or health hazard
- Hazard mitigation: Control or remove the hazard
- De-energize and protect the sources of electricity, fluids, hydraulics, and so forth

Slide 66

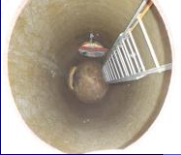
VICTIM CONTACT BY PRIMARY RESPONDER

- Establish victim location
- Primary medical survey (ABCs)
- Determine mode of injury
- Begin psychological first aid
- Determine feasibility of safe retrieval and retrieve if possible

Slide 67

SIZE UP

- Information gathering
- Resource identification
- Primary responder report
- Brainstorm strategy: risk/reward
- Incident management system (IMS)
- Team member assignments



67

Slide 68

SIZE UP

<ul style="list-style-type: none">● Distinction between rescue and recovery● Scope and Magnitude● Additional Resources● Location and Number of Victims● Risk Benefit Analysis● Separation, isolation, interviewing, security of witnesses	<ul style="list-style-type: none">● Hazards- utilities, mechanical, hazmat● Access to Scene● Environmental Factors
--	--

68

Slide 69

RISK ASSESSMENT

- Determines:
 - “What” can occur,
 - “When” (how often) it is likely to occur,
 - “How” bad the effects could be.
- Methods:
 - Checklist
 - “What if ?” Scenarios

69

Slide 70

RESCUE VS. RECOVERY

- Based on Risk/Benefit Analysis
- Duration of the operations
- Mechanism of Injury
- Environmental conditions
- Victim access

70

Slide 71

PRINCIPLES OF RESCUE


- (Best) Self Rescue
 - Establish Communication With Victim
- (Next Best) Non entry rescue
- (Most Risky) Entry Rescue

71

Slide 72

PREPARATION

- Rescuer personal protective equipment
- Anchoring and rigging rescue equipment
- Authorized entrant review



72

Slide 73

SAFETY

Back up team with their own air supply ready to go to rescue the primary team

73

Slide 74

PRE-ENTRY MEDICAL EXAM

- Similar to Haz-Mat
- Vital signs should be compared to a predetermined baseline
- Exam should be documented
- Psychological issues should be considered
 - Claustrophobia

74

Slide 75

CONDUCTING A SYSTEM SAFETY CHECK


- Tech rescue safety officers
- Acronym - ABCDE
- Never check something you built
- Start at the anchor end
- Check all knots
- Check all carabineers
- Check edge protection

75

Slide 76

ACCESS PATIENT



- Designate access team leader: one team leader for each group of two or more
- Utilize rescuer retrieval (high-point)
- Designate backup personnel



Slide 77

STABILIZE AND PACKAGE THE PATIENT



- First aid to life-threatening injuries
- Secure packaging for rescue transport
- Plan for movement of victims and rescuers



Slide 78

EVACUATE

- Move victim to a safe location
- Provide medical report to EMS
- Remove rescuers
- Emergency retrievals



Slide 79

RESPONSE TERMINATION

- Pick up and inventory gear
- Decontaminate (if necessary)
- Rebuild gear packages for the next call
- Field-evaluate rescuer mental state

79

Slide 80

DECONTAMINATION

- Consider decontamination if operations are in potentially contaminated spaces.
 - Hazardous Materials
 - Sewage
 - Flood Water
- Ensure appropriate equipment / personnel are available.

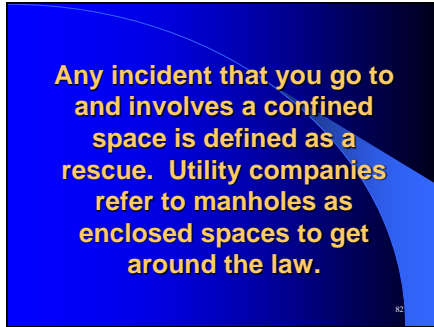
80

Slide 81

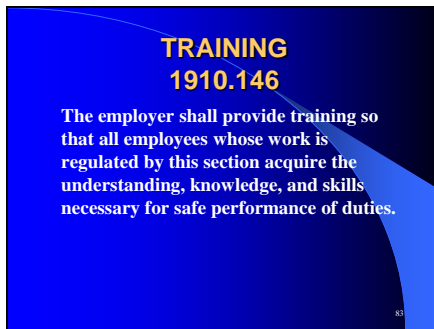
OSHA requirements are out there to minimize the risk to us as rescuers and the people who work around confined spaces.

81

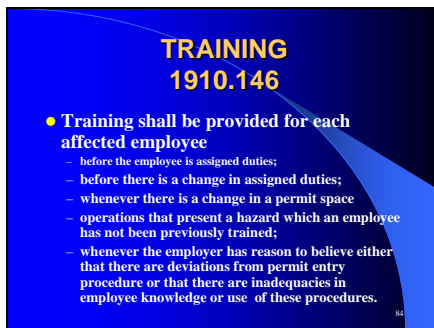
Slide 82



Slide 83



Slide 84

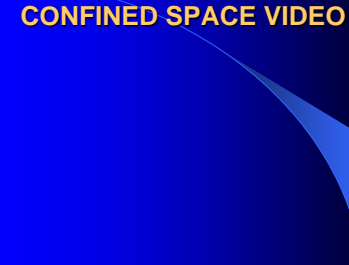


Slide 85

TRAINING 1910.146

- The training shall establish employee proficiency in the duties required by this section and shall introduce new or revised procedures, as necessary, for compliance with this section.
- The employer shall certify that the training required has been accomplished through: Documentation containing: employees name, trainers signature or initials, dates of training. The certification should be available for inspection.

Slide 86



CONFINED SPACE VIDEO

56

Slide 87

SUMMARY

- OSHA 1910.146
- Atmospheric Monitoring
- Equipment/Personnel Limitation
- Size Up
- Hazard Assessment and Control
- Phases of Rescue

87
